

**APPLICABILITY OF PRIORITY BASED FIXED ASSET
MAINTENANCE IN CONSTRUCTION
CONTRACTORS: A CASE FROM SRI LANKA**

G.R. Vidana Arachchi

(188733L)

Degree of Master of Science

Department of Civil Engineering

University of Moratuwa

Sri Lanka

October 2022

**APPLICABILITY OF PRIORITY BASED FIXED ASSET
MAINTENANCE IN CONSTRUCTION
CONTRACTORS: A CASE FROM SRI LANKA**

Geethike Ranga Vidana Arachchi

188733L

Thesis submitted in partial fulfillment of the requirements for the
degree Master of Science in Construction Project Management

Department of Civil Engineering

University of Moratuwa

Sri Lanka

October 2022

DECLARATION PAGE OF THE CANDIDATE & SUPERVISOR

I declare that this is my own work and this thesis, does not incorporate without acknowledgement any material previously submitted for a degree or Diploma in any other University or institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

Also, I hereby grant to University of Moratuwa the non-exclusive right to reproduce and distribute my thesis/dissertation, in whole or in part in print, electronic or other medium. I retain the right to use this content in whole or part in future works (such as articles or books).

UOM Verified Signature

Signature: Date: 10/11/2022

The above candidate has carried out research for the Masters Dissertation under my supervision.

Name of the supervisor:

Signature of the supervisor:

Date :

ABSTRACT

Construction industry is identified as one of the most asset intensive industries. The dependance on fixed assets such as construction machinery, equipment, plant and vehicles has made industry vulnerable to failures due to not having standard practices of utilization of these fixed assets. Being a fast-moving economy in South Asia, Sri Lanka is yet to fully standardize its Construction Industry and resources utilization. The published literature suggest that it heavily depends on utilization of better Fixed Assets and Fixed Asset Maintenance Systems (FAMS). Implementation of FAMS has been a challenging task for local contractors as failure cases have seen in the recent past frequently. Delays, idling, accidents, environment damage, low service level and less efficiency of fixed assets could be identified as major drawbacks, which in return produced finance outflow from the organizations. This paper elaborates on existing maintenance approaches like corrective, preventive and predictive while aiming to research the validity of Priority based Fixed Asset Maintenance approach (PFAM) in local Construction Contractors. Based on previously conducted relevant researches of more than 5 authors, it was decided to conduct a questionnaire survey followed by a Delphi consensus to establish priority parameters on a randomly selected sample of 56 organizations to develop a suitable priority score framework. Based on the survey responses and expert opinion, Physical Condition (PC), Performance (PER), and Criticality (C) were identified as three main priority categories under which sub-priority factors were determined. 33 construction equipment were selected from a road construction company and assigned priority scores to validate the suggested methodology as a case study. 54.4% of all the contractor organizations have classified their fixed asset register including construction equipment, office equipment, spare parts or service units, furniture and fittings, plant and machinery, building and land and building fixed asset categories which are stated by IAS 16 global standard and LKAS 15 local standard. It could be concluded that majority of contractors still utilizes 'fail and fix' or 'preventive' maintenance approaches, where there is technical possibility implement PBFAM practices. The priority score framework has shown substantial validity while testing with the local road contractors with real world data.

Key words : Fixed asset management, priority based fixed asset maintenance, corrective, preventive and predictive maintenance.

ACKNOWLEDGEMENT

It is a great honor for me to present this thesis to the Faculty of Engineering conducted by the Department of Civil Engineering, in partial fulfillment of the requirement for the degree of Masters in Construction Project Management.

I would like to express my deep & sincere gratitude to my principal supervisor Professor Asoka Perera, Faculty of Engineering, University of Moratuwa. His encouragement, supervision guidance and constructive comments enabled me to develop an understanding of conducting a research project in a consistent and effective manner. I sincerely grateful for the time & energy he dedicated on me.

I owe my deepest gratitude to our Departments Degree Program Coordinator Dr. Chandana Siriwardena, Faculty of Engineering, University of Moratuwa and the entire lecturing panel for valuable lecture series provided a value addition to the thesis.

Finally, I express my loving thanks and indebtedness to my parents and my dear colleagues. Without their sacrifices, patience, encouragement and moral support, completion of this task would not have been possible.

TABEL OF CONTENTS

DECLARATION PAGE OF THE CANDIDATE & SUPERVISOR	iii
ABSTRACT	iv
ACKNOWLEDGEMENT	v
TABEL OF CONTENTS	vi
List of Tables.....	ix
List of Figures	x
List of Abbreviations.....	xi
List of Appendices	xi
1 Introduction	1
1.1 Background of the Study.....	1
1.1.1 Maintenance of fixed assets	1
1.1.2 Pre-historical non-asset intensive construction approach	1
1.1.3 Fixed asset management and lean construction approach.....	2
1.1.4 Fixed assets utilized in construction industry	2
1.1.5 Importance of asset maintenance planning and decision making	3
1.1.6 Adverse outcomes of existing asset management approaches	3
1.2 Applicability of priority based fixed asset maintenance (PBFAM) in Sri Lankan construction industry	4
1.3 Similar studies conducted in the world	5
1.4 Research problem.....	5
1.5 Research questions	5
1.6 Research objectives	6
1.7 Significance of the study	6
1.8 Limitations of the study.....	6
1.9 Research methodology	7
1.10 Guide to thesis	7
2 Literature review	8
2.1 Introduction	8
2.2 Dependency of construction on assets	8
2.3 Equipment and machinery used in construction	9
2.4 Classification of fixed assets	10

2.5	Standards in physical asset management	11
2.6	Poor fixed asset management as a root cause for construction project failures.....	13
2.7	Approaches to maintain fixed assets	14
2.7.1	Corrective maintenance (CORM)	14
2.7.2	Preventive maintenance (PREVM)	14
2.7.3	Predictive maintenance (PREDM).....	15
2.8	Priority based fixed asset maintenance (PBFAM)	15
2.9	Sri Lankan construction industry and its recent trends	16
2.9.1	Industrial economic sector in Sri Lanka.....	17
2.9.2	Statistics of Sri Lankan construction industry.....	17
2.9.3	Lessons to be learned from manufacturing industry	18
2.10	Applicability of priority based fixed asset maintenance in local contractors	18
2.11	Summary of literature survey	19
3	Methodology	20
3.1	Introduction	20
3.2	Development of the research methodology.....	20
3.3	Definitions of key technical terms	23
3.4	Key components of the research methodology	25
3.4.1	Preliminary literature review and data collection	25
3.4.2	Detail literature review	25
3.4.3	One to one interview and Delphi consensus	26
3.4.4	Questionnaire survey.....	26
3.4.5	Case study - Data validation ground survey.....	27
3.5	Population.....	28
3.6	Sample.....	29
3.7	Analytical Techniques.....	29
3.7.1	Descriptive statistics.....	29
3.7.2	Central limit theorem	30
4	Analysis and discussion of results.....	31
4.1	Analysis of one-to-one interviews.....	31
4.1.1	Analysis of statistics related to Experts.....	32
4.2	Analysis of Delphi consensus	34

4.3	Analysis of the questionnaire survey responses	37
4.3.1	Diversity of the survey audience	37
4.3.2	The existing FAM approaches	38
4.3.3	The existing ground conditions related to fixed assets	39
4.3.4	Classification of FAM Methodology	41
4.3.5	Technical possibility to prioritize fixed assets maintenance	43
4.4	Analysis of priority scores of field data collected – The case study analysis	46
5	Conclusions and recommendations	52
5.1	Practical Implications of the study	52
5.2	Further research areas	52
5.3	Limitations of the study	53
5.4	Research assumptions	53
5.5	Conclusion	53
5.5.1	Fixed asset management approaches	53
5.5.2	Existing conditions related to fixed assets	54
5.5.3	Technical possibility to prioritize fixed assets maintenance	54
5.5.4	Validity of priority based fixed asset maintenance methodology	55
	References List	56
	Appendix B: Questionnaire survey – lime survey platform	59

LIST OF TABLES

Table 1 Classification of fixed assets	10
Table 2 ISO Standards for Fixed Asset Management	12
Table 3 Causes of Construction Project Failure	13
Table 4 Main Factors to prioritize maintenance decision	15
Table 5 Construction contractor classification - CIDA.....	17
Table 6 Questionnaire sub sections.....	26
Table 7 Road construction Company's sites visited for data validation	27
Table 8 Descriptive statistics.....	29
Table 9 Analysis of one-to-one interviews - sub research areas	32
Table 10 Delphi consensus results	35
Table 11 Priority sub categories - Delphi output	36
Table 12 Descriptive statistics of satisfaction level of assets	39
Table 13 Descriptive statistics of frequency of happening adverse incidents.....	40
Table 14 Descriptive statistics of prioritization based on physical condition.....	43
Table 15 Descriptive statistics of prioritization based on performance	44
Table 16 Descriptive statistics of prioritization based on criticality	45
Table 17 Analysis of field data - framework validation.....	46
Table 18 Prioritized fixed asset list - Road Construction Company	48
Table 19 Finalized priority categories and factors	54
Table 20 Field Data Collection	Error! Bookmark not defined.

LIST OF FIGURES

Figure 1 PAS55 - Condition Monitoring.....	12
Figure 2 Suggested prioritization process by S. Wayne Myles and Frank C.....	21
Figure 3 Research methodology framework	22
Figure 4 Conceptual framework for PBFAM approach validation.....	28
Figure 5 Characteristics of the Population	28
Figure 6 Characteristics of the Sample	29
Figure 7 Data analysis process flow chart.....	31
Figure 8 Statistics of the expert team	32
Figure 9 Diversity of the survey audience	37
Figure 10 Existing FAM approaches	38
Figure 11 Availability of additional documentation	38
Figure 12 Satisfaction level regarding assets	39
Figure 13 Frequency of happening adverse incidents	40
Figure 14 Classification of maintenance approaches	41
Figure 15 Prioritization based on Physical Condition.....	43
Figure 16 Prioritization based on Performance.....	44
Figure 17 Prioritization based on Criticality	45

LIST OF ABBREVIATIONS

Abbreviation	Description
BC	Before Christ
C	Criticality
CBRM	Condition based risk management
CIDA	Construction industry development authority
CORM	Corrective maintenance
FAM	Fixed asset management
GDP	Gross domestic production
IAS	International accounting standards
ISO	International standards organization
LKAS	Sri Lankan accounting standards
PBFAM	Priority based fixed asset maintenance
PC	Physical condition
PE	Performance
PREDM	Predictive maintenance
PREVM	Preventive maintenance

LIST OF APPENDICES

Appendix	Description	Page
Appendix B	Questionnaire survey lime survey platform	60